

Taking Risks as a Feature of Creativity in the Teaching and Learning of Design and Technology

Abstract

This article considers the nature of risk taking and its determinants in relation to teaching and learning design and technology in secondary schools. It is informed by research into the contribution that creativity makes to design and technology education, including an analysis of the risks that teachers and students take when working within a domain.

Design activity can require a creative leap to realise acceptable solutions, which are valued by clients and customers. This process involves taking risks with the use of materials, with the development of processes and with those people who fund development work and clients. In design and technology education the risks are different. Legal responsibilities for products that students create are limited in relation to their effectiveness. Risks taken by teachers are mainly governed by the need for students to achieve success in their learning. For the students, it is their ability to achieve success linked to management of their personal resources of time and energy, in addition to their management of affective factors such as confidence, anxiety levels and motivation.

Introduction

The arguments for technological education as a specified component of the National Curriculum are at the vortex of change in schools.

"Technological education is the only subject in schools that has ever followed an experiential pedagogical philosophy – one that is in harmony with the natural and manufactured worlds, and with the way societies adapt to their environments." (Hanson and Froelich, 1994 p.192)

Traditionally, in secondary schools, technology education has been associated with a craft paradigm linked to vocational determinants or to applied science. Here the purposes are clear, the skill and knowledge base easily definable. Custer however argues coherently that:

"technological knowledge is necessary but not sufficient for technological activity". (Custer, 1995 p.231)

Currently, the demands are for greater transferability of knowledge and skills to work in different meaningful contexts, based on integrating cognitive and practical abilities.

The main concerns with design and technology problems are likely to hinge around the following questions:

- Will the outcomes work efficiently and safely?
- Can the job be done within cost and resource constraints?
- Will approval be given by the client and others likely to take an interest?
- Will it be beneficial? In the event of problems being encountered, what will be the nature and measure of failure and will losses be recouped? Over what term?

The commercial rewards for originality are huge, for industry dealing with a sophisticated customer base such as those in western societies. This is always a requirement to deal with associated risks.

Since the inception of National Curriculum Technology, teachers have been subject to many influences with respect to how the subject should be taught. Many problems have resulted which have often been linked with shallow learning experiences and sometimes coupled with 'creativity'. In the current political climate, there is caution about how much freedom should be given to schools, teachers and learners to be creative. There are concerns that:

- 1) it might not show immediate gains in knowledge skill and understanding
- 2) valuable time might be wasted
- 3) creative success is difficult to measure and not subject to universal agreement.

It is argued by Richard Kimbell:

"that the dead weight of a national curriculum runs the risk of placing a dead weight on innovation – discouraging imaginative teachers and schools from developing their curricula with the consequence that pupils develop a narrow view of their world unrelated to their society". (Kimbell, 1996 p.99)

This is despite an economic imperative driving the recognition of the need for design and technology to be present in the curriculum. It is apparent that amongst industrial and commercial bodies that 'creativity and problem-solving are desirable qualities for citizens of the 21st Century'. (Joyce, Franklin, Neale, Kyffin and Veronesi, 1998 p.113)

It is within this climate, against a backdrop of debate about the role of creativity in school design and technology that this article examines how teachers and their students deal with risk and uncertainty in the teaching and learning of design and technology.

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Human responses to risk

In order for an individual to take risks, outcomes have to show potential benefit to the individual through identifiable gains. Risk thresholds are personal, resulting in 'high risk-taking' to 'risk aversion'. Facing risk implies emotional exposure and adrenaline flow and it is likely that responses will reflect the general capacities and tendencies of individuals to face and cope rationally with stress. Responses are also 'context-based' in that people are prepared to tolerate and actively manage different types and degrees of risk dependent upon the situation. Literature on risk indicates that responses to risk are frequently irrational, reflecting their multidimensional nature but Singleton and Hovden believe there is in general 'a close correlation between perception and behaviour'. (1987)

In the literature associated with risk studies, there is extensive recognition that as human beings we are much more likely to accept risks on a voluntary basis than through coercion. Knowledge and personality, however, directly affect our response to risk-taking, which is always associated with the making of choices and decisions, which can change a course of events. This can include the option of not making a choice or decision, whenever a problem is presented to be solved.

Creativity and its contribution to design and technology**Children and creativity**

Children begin their lives with a strong disposition to explore and develop an understanding of the world around them. Links are forged between the components of their understanding as it evolves and the desire to experiment and gain wide experience in divergent areas. Propositions concerning the nature of convergent and divergent thinking and their relationships to creativity emerged as a result of the work of Hudson, Torrance and Guildford. Guildford (1957) states that young children are largely locked into divergent thinking, which is essentially creativity based. As world experience increases for children, so does the propensity for analytical thinking, as their depth of understanding of domains and fields increases. Based on this, Beetlestone (1998) refers to 'little' creativity, or creativity for all, which is particularly pertinent in classroom situations:

"In considering creativity it is important to establish that all children have equal rights to be creative and to have full access to opportunities within the creative areas of the curriculum." (Beetlestone, 1998 p.34)

She recognises that creativity has cultural dimensions and that children do not all respond to creativity in the same way:

"We do not perceive that all children have equal gifts and indeed we may ascribe differences to perceived notions of ability, class, race, gender and able-bodiedness." (p.34)

Creativity in classrooms

The opportunity for children to grow creatively in classrooms would appear to depend critically upon how support (scaffolding) is maximised through teachers, peers and parents. This is an area little researched and understood in design and technology, but defined and discussed generally by Vygotsky (1978), Gardner (1995), Rogoff (1990), and in specific classroom terms by Fryer (1996) and Beetlestone (1998).

Characteristics associated with creativity, particularly in the affective domain such as doggedness and singlemindedness, can result in disruptive classrooms. It has been known that particularly creative individuals are often very demanding of themselves and committed to their task. They are often 'difficult' individuals, sometimes surrounded by tragedy and often marginalised from 'ordinary' communities. Selfishness, intolerance and stubbornness are often present and there is an enjoyment of complexity and asynchrony which if not present, is sought (Koestler, 1964; Feldman, Csikszentmihalyi and Gardner, 1994). Teachers can find it difficult to sort out more random disruptive behaviour from that associated with children taking up creative challenges. If teachers are limited in their own creativity, what impact will this have on children? Given the often identified 'domain specific' nature of creativity, what relationships and values develop as a result of children's experience of creativity in the different subjects of the curriculum? Gardner clearly posits separate 'types' of creativity associated with each form of intelligence. (Gardner, 1995)

Moyles (1989 p.78) believes that:

"As teachers we need to be involved in observing, initiating, participating, encouraging, maintaining and extending children."

Educational writers such as Alexander *et al* (1992), Beetlestone (1998), Shallcross (1981), suggest that the ultimate endeavour of teachers is to promote creative acts and release creative potential. They however recognise the levels of difficulty in achieving the conditions, with respect to the

characteristics of individual children, the domain within educational settings and the values associated with the field.

Creative designing

Creativity is a little used term in the field of design and technology education, but problem-solving isn't. Design and technology capability is the National Curriculum defined term which locates the capacity to deal with design problems. Hilgard proposes two major approaches to addressing these through problem-solving and creativity:

"the first of these relates problem-solving to learning and thinking, as a type of higher mental process or 'cognitive' process. The second approach, supplementary rather than contradictory to the first, sees creative problem-solving as a manifestation of personality and looks for social and motivational determinants instead of (or in addition to) purely cognitive ones." (Ed. Anderson, 1959 p.162)

Technological problems are human problems and involve taking risks to improve lifestyle and the general good of society. David Wann (1996) argues, that all things in the natural world are interconnected: in framing a solution to a particular human problem, its impact on other systems must be considered in order to address matters such as pollution, erosion, congestion and stress. Design decisions in today's world should only be taken after full consideration of the impact on human beings. This implies consideration of people's values, beliefs, concerns and fears in addition to consideration of their cognitive, physical and emotional attributes. Fundamentally, the question always to be asked concerning any design problem is: "Am/are, I/we prepared to pay the costs?" The decision will depend on whether the gains are seen to be worthwhile and consistent with visions and hopes.

Creativity and risk-taking in design and technology classrooms

Design and technology education is concerned with learners developing the skills, knowledge, understanding and attitudes associated with producing and using technological outcomes. To most learners, the effectiveness of their work is judged by the quality of the products they make whilst the teachers are also concerned about development of the processes. Students are not exposed to the accountabilities of having products that customers depend upon. Failure is not likely to be catastrophic and no litigation is likely as a result of in-appropriate product specifications. Indeed, most outcomes

tend to be concrete or functional models.

Additionally, this means that students do not share the motivating advantage of seeing their products usefully used, serving purposes. Their ability to appreciate the worth of taking risks is therefore limited to balance their investment of time and application of effort. This is particularly so if design and technology is not held in appropriately high esteem.

Bill Gates of Microsoft writes:

"Most people have had the experience of getting interested in a topic and feeling the gratifying sense of accomplishment that comes from finding good material on it, and the pleasure of mastering the topic. But if a search for information brings you up against a blank wall, you become discouraged. You begin to think that you are never going to understand the subject. And if you experience the reaction too often, especially when you are a child, your impulse to try again is diminished." (Gates, 1995 p.192)

The role of 'significant others' but particularly teachers and/or parents in the student's frame can make the critical difference between failure being a negative or positive learning experience.

The research context for examining risk-taking by teachers and students

The findings from the author's research into the contribution that creativity makes to design and technology education has established the need for more deliberation about risk assessment and risk management. The way that teachers work with students, their approach to the organisation and delivery of the subject and the way students react to their situation has been investigated. A field study was set up with a girls' secondary school in a small town in the Home Counties. The methodology used was tailored to identify creative acts associated with students' design and technology work, then to have in-depth, semi-structured interviews with teachers and students concerned. The personal construct theory of George Kelly (1955) informed the data-collection process which allowed me to gain access to the constructs (personal creations of meaning) of the respondents. From the data, it is possible to make causal connections between what the respondents understood and believed and the actions they were responsible for in teaching and learning situations.

The teachers were initially invited to select six products created by students that they thought were interesting. They were 3-D in the main and occasionally 2-D but gave a focus for

discussion about the processes that both students and teachers were involved in to produce the outcomes. Towards the end of the interview, two or three products were chosen as having an interesting aspect of creativity associated with the process of production. Each student 'owner' was subsequently interviewed about them. The interviews were subsequently transcribed, coded and analysed.

Interviews with three design and technology teachers (one with a textiles background, one resistant materials and one food) and eight student are used to illustrate the findings from the research.

Risk-taking by teachers of design and technology

Institutional constraints affect the degree to which teachers are prepared to trust students and construct challenging tasks and contexts for them to work in. All of the teachers interviewed recognised fully the self-limitations that exist in design and technology teaching situations. They also felt the need to be self-critical about their professional effectiveness in order to enable learners to maximise their potential. All teachers perceived, however, that projects offering challenge were 'high risk' to support. This was because of their desire to ensure that students achieved success, which was their dominant concern when teaching to produce a positive, engaging, climate.

The major accountability influencing each teacher's role and approach includes encouraging students to opt for examination courses and subsequently succeeding in them. A direct implication of this need is encouraging students to value their experiences and make progress in line with course expectations. Teacher X recognised that in order to obtain the best from her students, she had to push them often beyond what they thought they were capable of achieving. Logistical constraints of curriculum organisation and delivery often cause failure without any consequent opportunity to turn this into a learning experience e.g. to run out of time on a project is always likely within often 'unfriendly deadlines'. She felt that the penalty she suffered was students blaming her for their failure and consequently becoming negative about the subject. 'Safe' work with students offers them tasks that are tightly constrained, in turn creating security. This approach precludes an experience of the motivating effects of success and recognition of progress beyond self-expectation:

Interviewer

"When girls come up with ideas of their own which they want to develop how do you deal with that?"

Teacher X

"Well I usually say 'is it possible to do this?' and then I talk through the various problems that might occur. I need to be convinced that they have thought through the issues and done the necessary research and will they be able to finish in time – the practical things. I think occasionally where someone has thought of a good idea, I want them to have a go at this and sometimes they don't quite finish, they are disappointed and I find it very difficult to make them feel better about the quality of the work that they have done – I feel I carry a lot of 'blame' for this then."

X understood how important her leadership and credibility was with students and the fragility of the trust they place in her. In a school culture which can mitigate against 'practical learning', she realised that her task was a difficult one. For personal success, she needed her students to gain rich rewards. She tried to value them as individuals, challenge them constantly but in a supportive framework that attempts to minimise the senses of 'loss' and 'fear' associated with failure. A way she tried to achieve this was to keep open 'two-way' lines of communication and to be closely involved with each individual's work from the ideas stage.

Teacher X

"...they don't want to fail. I had one girl who made a hair-band – she was Year 7 and doing the healthy heart project and it wasn't as good as she thought it would be and said "I could do so much better now," and she was quite disappointed with the result. But she thought it through and that was very rewarding for me because she had actually learnt so much and knew that she could do better. It was a disappointment for her, but we did talk it through and she was fine then. But you can learn a lot through failure."

X's overriding confidence in her work meant that she consciously tried to make progress with the difficult problems facing her. She sought to know more, see more and understand the cause – effect relationships that existed. Gaining success in her work through promoting student achievement and progress linked to the resources and support that she received to teach. She was conscious of managing risks with student values, attitudes and motivation.

Teacher Y found students' value systems difficult to deal with, particularly in the light of their frequent rejection of the subject at the end of Key Stage 3. She felt pressure from teaching a subject which the students compare, often unfavourably, with other subjects, due to value systems outside her control. She had to define the stages in her own teaching where she felt able to trust students to undertake different levels of open-ended activity, but questioned whether or not sufficient opportunity was created for student creativity. Her own judgements were based on maximising the impact of her own teaching to account for the needs of each whole class, not the individuals within them:

Teacher Y

"...Where also the groups are smaller for design and technology – perhaps 15 and they can act more independently. At a lower level briefs will be set in such a way that they have to be more constrained in their responses."

"...I just wonder whether we maximise our opportunities for creativity or not in the tasks that are set. At times it feels – this is quite a difficult one to put into words – but – it is whether we use the materials to best advantage with the children."

Failure in the student's eyes is construed to be a product that didn't work or did not look nice. Her planning and teaching were constructed on the basis of reducing the possibility of this occurring. Being creative, and hence taking risks more generally, was not perceived to be in tune with National Curriculum requirements and hence not promoted actively through the teaching.

Teacher Y

"So if I were measuring creativity I would have to be more sensitive to individuals but I have to appropriately take account of National Curriculum requirements which don't allow for that."

Y's professional interpretation of her subject was such that creativity was an important element, for which her own and student motivation was crucial. She frequently stated the need to set up tasks and encourage students in ways that develop motivation. She felt that boys were more capable of creative activity than girls because they are more prepared to take risks.

Risk-taking by students

The response of students to their handling of risk appears to depend on what had been gained through prior experience. Examples of the responses from three students indicate comparative stances on risk-taking and links

to environmental factors and influential relationships. For student A, observations of the world about her resulted in an appreciation of the need for risk-taking and risk management. Her experiences however, left her frustrated, and in some senses the cause of what she perceived as her inability to reach her potential. This was however within the context of how she interpreted subject objectives of design and technology as skill based. She spoke confidently about the circumstances when she was prepared to take risks:

Student A

"I am quite prepared to take risks with some things. I think on the tie-dyeing as well, I didn't know – I had never – I used elastic bands – that's not much of a risk – I didn't know how it was going to turn out – instead of the string, I thought if I used elastic bands it might be quicker. I didn't know whether it would turn out naff but it worked out alright."

Interviewer

"Yes so that is one example – you said it wasn't much of a risk, but do you think that was a big risk for you as an individual?"

Student A

"I think it could have gone wrong if the elastic band hadn't worked. I could have ended up with nothing."

The main inhibitor to following her inclination for risk-taking is her mark profile and concern for examination success.

B was used to thinking carefully about her projects, but not when they were closely prescribed. She however also enjoyed changing direction mid-project and the surprise element of unexpected success. Indeed, she associated this with the production of her best and most inventive work. Interestingly, she was the least positive about her best planned project which was food-based:

Student B

"I hated repeating the various bits to get the result I needed."

Being driven by a dislike of mistakes and failure, she was prepared to apply time and effort to ensure success. There was a sense in which she detected the anxiety of teachers who tried to ensure her success through offering solutions that she found unacceptable. She reacted negatively to this in response to the way in which she herself weighed up risks and planned her activities:

Student B

"I won't do what I think is just acceptable for the Teacher. I like to try and go for what I think will be an interesting project."

Interviewer

"Do you think you always make maximum effort with you work for design and technology in school – do you?"

Student B

"I don't know."

Interviewer

"Does it vary?"

Student B

"Yes. Some things I did, I could do better, things that I don't enjoy then I tend to work less. Things that I do enjoy I try to do well."

In rejecting a teacher's advice, she was comfortable in using diplomacy skills with her teacher to achieve her objective even though she knew what the limits were. Whilst examination success was a factor in her thinking, it was not so pervasive as to prevent her from challenging a teacher's judgement. If she failed to persuade a teacher of the merits of an alternative approach, she rejected the worthwhileness of the project:

Student B

"If I think I am right I will argue the point with her, I will try and get out of following her instructions if I don't see the sense in them."

Interviewer

"Do you complain about the decisions, the way the teacher tries to control all of what you do?"

Student B

"Sometimes, I try through reasoning and making other suggestions."

C was a risk manager and understood some of the basic requirements to avoid the pitfalls of failure in the subject. She recognised that attention to detail was important and that quality complex solutions to problems were difficult to create and because of confidence limitations tended to go for simple solutions.

Interviewer

"How much of a risk do you think you take when you make things out of clay and plastic and the other materials you use?"

Student C

"I am not really very confident. I prefer it to be simple than hard and not turn out very well."

Originality is a highly fraught area which demands creative leaps which don't always work for her. From her observations of teachers and parents successfully predicting her potential to deliver outcomes, she recognised that she lacked some key analytical skills. Creative solutions demand inner confidence and she perceived, rightly or wrongly, that some of her peers were better at it than her. This resulted in a cautious approach with her preparation and when tackling innovative solutions to problems resulting from difficulties with affective factors. The responses she made to tasks usually left her satisfied due to the good levels of support and mentorship she received which she positively acclaimed. She also expressed her enjoyment of surprise in the subject, which she claimed was important to her. Novelty value was sometimes added through surprise results.

Interviewer

"So tell me about product no.3 then. What was novel about that – you told me about getting rid of the scratches and it surprised you. You used the word surprised – it surprised you. In what way?"

Student C

"I was surprised that the scratches went so easily after filing and using the wet and dry paper on them. All of the scratches just went. They went with just an extra bit of work."

Interviewer

"And it was that which made you feel good about the project?"

Student C

"Yes."

Sometimes when risks were taken successfully, they secured a pathway to a more difficult problem resulting in greater satisfaction and higher standards. Claiming ownership of a task and exercising responsibility appeared to be a major motivating force for risk-taking in certain situations.

Interviewer

"...if your teacher told you that it was important for you to get good marks for your work. Would that affect how much of a risk you were prepared to take?"

Student C

"Probably to a certain extent but I wouldn't do something really, really simple just for that. I would still take risks but not probably the biggest ones which I would take without that mark."

Interviewer

"If the teacher advised you not to do something because they thought that it wasn't appropriate but you really wanted to have a go at something, what would you do?"

Student C

"I would probably do it."

Interviewer

"You would still do it?"

Student C

"Yes."

Risk-taking with the task was actively managed where products were being made for particular purposes or clients. C was very articulate about the measures she takes involving paper-planning and discussion to ensure a result that would be likely to succeed in meeting with approval. Sensitive support from mentors and the closely related clients, for whom she produced work, gave confidence to C. This enabled her to both experiment further and increase the sophistication of the procedures she was using, to generate high quality responses.

Pride and enjoyment was often gained from success with simple skill-based tasks. Several students admitted low confidence levels and backing off high risk strategies that contained a chance of failure. Where confidence levels were high, they were sufficiently confident to learn from failure. Some intellectualised the relationship between learning and failure, but did not feel strong enough to face real challenges for their ability. They satisfied themselves by minimising risk working within the domain of 'personal creativity'.

Emergent issues

The professional qualities that teachers possess and their approaches to classroom management and learning are important in assessing and managing risks with teaching and learning. There is a need for teachers to recognise when and where students are required to take risks in their learning and the impact that failure might have on their attitudes, values and dispositions. Risks with relationships, both inside and outside classrooms, can often influence student behaviour and response linked to their progress and attainment. This emphasises the importance of developing a classroom climate in which risks in the following categories are exposed and faced:

Teachers' professional qualities

- lack of personal skill and aptitude designing and/or making will randomise and not rationalise students' exposure to risk in their learning

- values form the baseline for working – but whose values? If the teacher promotes a narrow system of social or subject-based values, they can induce hostility and promote rejective stances amongst students.

Student needs

- low levels of capability in the core skills of literacy and communication can prevent a student from asking questions, enlisting support from others and developing a well thought-through solution to a problem
- individual learners require responses to their own difficulties and problems which reflects both their knowledge and feelings
- recognition of success and giving constructive, measured, feedback to learners is important to enable students to develop risk management strategies.
- inability to achieve personal expectations can lead to frustration and a feeling of helplessness
- lack of success over time with the range of tasks and activities can be accumulatively damaging to student motivation

Teaching approaches

- avoidance of decision-making is often perceived to be the easiest response to a dilemma but the one that can lead to the least effective solution
- if the teacher chooses to make decisions on behalf of a student, they might not necessarily act in a student's best interests overall. If teachers and learners share the risks associated with the learning process, better quality learning is likely to be achieved.

Teachers' expectations

- rich, varied contexts and appropriate expectations of performance can promote interest, ownership and appropriate risk-taking
- teachers sometimes misconstrue or ignore the prior learning and experience of students
- teachers feel that there are likely to be differences in the dispositions and responses of boys and girls towards risk-taking.

Curriculum structure

- a fragmented curriculum structure can reduce motivation levels
- the requirement to complete project within the boundaries of time and materials which exist in schools can be very

limiting. Even though rich progress might have been made, the learner who does not have a polished outcome to show for their endeavour might still perceive failure

- inability to match product quality to initial ideas in either function, form, or both, can lead to frustration and rejection.

Relationships

- loss of face with peers, which may be covered-up by a 'don't care' attitude, leaves an emotional scar and negative attitude if not attended to and faced through a teacher/learner relationship
- loss of face with teachers, whilst students usually work hard to satisfy a teacher's expectations, they would not do so at the expense of going against the peer group culture which might be 'anti-learning'. Students will do enough to get by without becoming a 'swot'.
- group work places expectations on individuals. Whilst offering the opportunity to share risk taking, the exercise of control by one student can limit achievement for others according to the nature of the social hierarchies operating.

Conclusion

"A life without adventure is likely to be unsatisfying, but a life in which adventure is allowed to take whatever form it will, is likely to be short." Bertrand Russell (quoted in MacCrimmon and Wehrung, 1986 p. 3)

Whenever choices are made about paths to follow in any human endeavour, judgements are required and risks are incurred. It is likely that some paths will lead to short term benefits, others longer term. The benefits of success are balanced by the impact of failure through any decisions taken. Creative work when designing and making is likely to bring about novel, or different knowledge which will incur risk-taking through "exposure to loss, the chance of loss (a sure loss is not a risk) and will require consideration of the likely magnitude of any losses." (MacCrimmon and Wehrung 1986 p. 9)

It is up to every educationalist with an interest in design and technology to weigh up the costs and benefits for themselves and reach considered views.

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